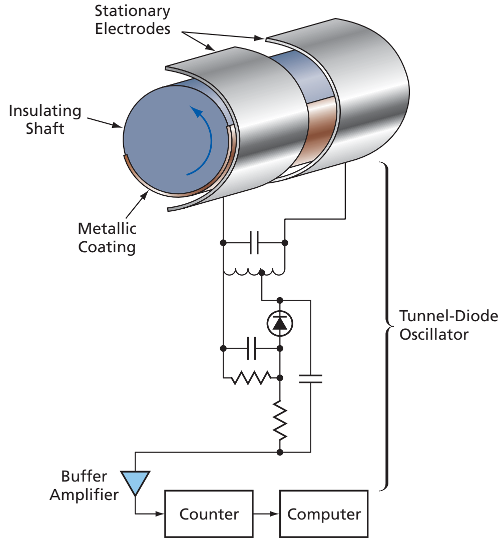
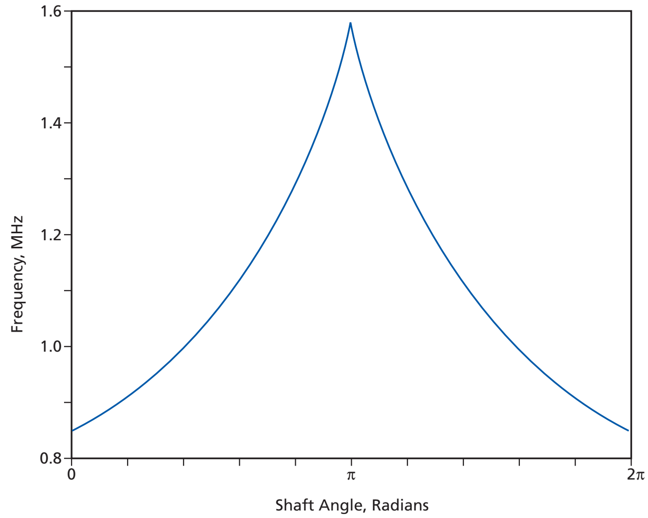



SHAFT-ANGLE SENSOR




SIMULATED EXAMPLE OF FREQUENCY VERSUS SHAFT ANGLE

The **Series Capacitance** between the stationary electrodes would vary as the shaft turned, causing the frequency of the tunnel-diode oscillator to vary.

the shaft, so that there would be a small radial gap between them and the outer surface of the shaft. Hence, there would be a capacitance between each stationary electrode and the metal coat on the shaft.

The stationary electrodes would be connected into a tunnel-diode oscillator circuit, so that the series combination of the two capacitances would be part of the capacitance that determines the oscillation frequency. As the shaft is rotated, the stationary-electrode/metal-coat overlap area would change, causing the series capacitance and the oscillation frequency to change. The frequency would be measured and used to infer the shaft angle from the known relationships among shaft angle, capacitance, and frequency.

It should be noted that a given frequency could signify either of two distinct shaft angles. If necessary, one could resolve the shaft-angle ambiguity by use of two sensors at different angular positions.

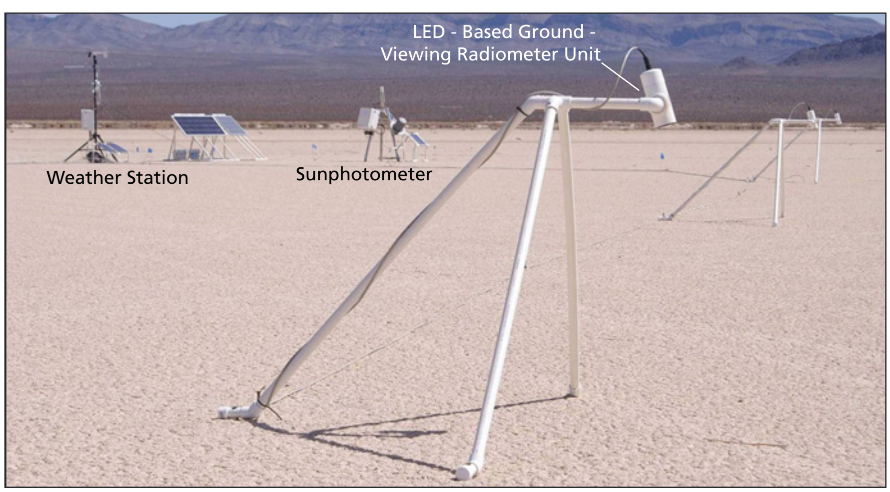
*This work was done by Talso Chui of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).*
*NPO-43328.*

# Ground Facility for Vicarious Calibration of Skyborne Sensors

### This is an automated facility that generates Web-accessible data.

*NASA's Jet Propulsion Laboratory, Pasadena, California*

An automated ground facility, for vicarious radiometric calibration of airborne and spaceborne sensors of visible and infrared light has been established. In the term "vicarious calibration," "vicarious" is used in the sense of "in place of another," signifying "in place of laboratory calibration." Vicarious calibration involves the use of ground truth in the form of measurements by ground-viewing radiometers, a Sun-viewing photometer, and meteorological instruments positioned in a ground target area. Typically, the target is a dry lakebed or other relatively homogeneous area. (The value of a relatively homogeneous target is that it minimizes effects of errors of registration between the target and the fields of view of sensors.) The




**Radiometric and Meteorological Instruments** are placed at the target site along with electronic power and communication infrastructure.

measurement data are processed by a radiative-transfer computer code to estimate spectral radiances at the position of a sensor known to be overhead at the time of the measurements. These radiances can be compared with the sensor readings to calibrate the sensor.

Previously, in order to perform vicarious calibration, it was necessary to dispatch field teams on expensive measurement campaigns to target sites, scheduled in accordance with sensor overpass times and weather conditions. Difficulty was compounded by remoteness and limited accessibility of typical targets. The present ground facility nearly eliminates the need for field measurement campaigns by acquiring data nearly continuously and making the data available to all interested parties via the World Wide Web.

The present ground facility occupies a target site consisting of the Frenchman Flat dry lakebed located north-northeast of Mercury, Nevada. The instrumentation at the facility includes a light-emitting-diode spectrometer (LSpec), which consists of eight tripod-mounted, ground-viewing radiometer units containing LEDs biased to operate as photodetectors (instead of light emitters) at their respective wavelengths. The LSpec provides an essentially continuous stream of measurements at eight discrete wavelengths. These are merged with spectral surface-reflectance measurements made on occasional site visits to obtain temporally continuous coverage with high spectral resolution. Other equipment at the site includes a weather station and a tracking sunphotometer (see figure).

Measurement data are acquired at intervals of 5 minutes under all daylight conditions. The data are entered into a database maintained on a Jet Propulsion Laboratory server computer. A remote user can log into a Web-based interface and request information specific to the overpass time of a given sensor. The data can be fed as input to the radiative-transfer computer program to obtain radiances for calibration of the sensor.

*This work was done by Carol Bruegge and Shannon Jackson of Caltech and Mark Helmlinger of Northrop Grumman Space Technology for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).*
*NPO-45425*

# Optical Pressure-Temperature Sensor for a Combustion Chamber

**This compact sensor would withstand the harsh combustion environment.**

*Marshall Space Flight Center, Alabama*

A compact sensor for measuring temperature and pressure in a combustion chamber has been proposed. Heretofore, independent measurements of high pressures and temperatures in combustion chambers have not been performed. In the original intended application, the combustion chamber would be that of a rocket engine. Sensors like this one could also be used to measure temperatures and pressures in other combustion chambers and other, similar harsh settings. There could be numerous potential applications in the aeronautical and automotive industries.

In the original rocket-engine application, accurate measurements of pressure and temperature are needed for feedback control to suppress combustion instability. Heretofore, none of the available pressure sensors have been capable of surviving the thermal environment of a combustion chamber without the use of sensing lines or helium-filled cavities. Pressure-measurement signals obtained by use of sensing lines or helium-filled cavities have altered power spectra that make the signals unsuitable as feedback signals for control purposes.

The proposed sensor would include two optically birefringent, transmissive crystalline wedges: one of sapphire ($Al_2O_3$) and one of magnesium oxide (MgO), the optical properties of both of which vary with temperature and pressure. The wedges would be separated by a vapor-deposited thin-film transducer, which would be primarily temperature-sensitive (in contradistinction to pressure-sensitive) when attached to a crystalline substrate. The sensor would be housed in a rugged probe to survive the extreme temperatures and pressures in a combustion chamber. An externally generated optical input signal would travel through parts of the wedges. The effect of the thin-film transducer on the propagating light beam would provide temperature information. The effect of stress-induced birefringence in the crystalline wedges upon the light beam would provide pressure information.

*This work was done by John Wiley of Marshall Space Flight Center, Valentin Korman of Madison Research Corp., and Don Gregory of the University of Alabama in Huntsville. For further information, contact Sammy Nabors, MSFC Commercialization Assistance Lead, at sammy.a.nabors@nasa.gov. Refer to MFS-32075-1.*

# Impact-Locator Sensor Panels

**Panels can be electronically daisy-chained and assembled to cover large areas.**

*Lyndon B. Johnson Space Center, Houston, Texas*

Electronic sensor systems for detecting and locating impacts of rapidly moving particles on spacecraft have been invented. Systems of this type could also be useful on Earth in settings in which the occurrence of impacts and/or the locations of impacts are not immediately obvious and there are requirements to detect and quickly locate impacts to prevent or minimize damage. For example, occupants of a military vehicle could know immediately that someone was shooting at it and which side of the vehicle was taking fire. For another example, commercial transportation companies using these systems for remote monitoring of valuable cargo could know when and from what